

NASA SBIR/STTR Technologies

H3.04-9315 - Vapor Compression Refrigeration System for Cold Storage on Spacecrafts



PI: Kunal Bansal

Air Squared, Inc. - Broomfield, CO

Identification and Significance of Innovation

NASA is looking for solutions for its long-term or distance food storage and transport applications. Achieving high thermal efficiencies while maintaining volumetric and mass efficiency has been the key challenge with these kinds of refrigeration/freezing systems in a microgravity environment due to the very low overall system COP of existing thermal electric systems.

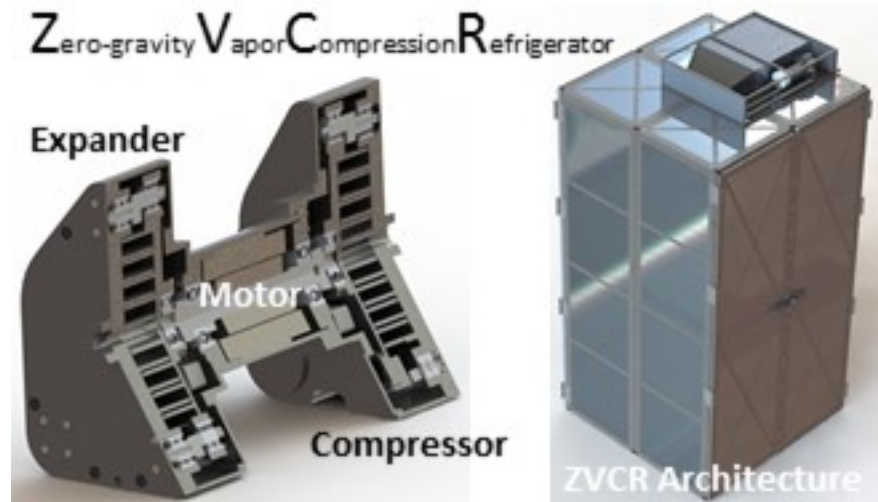
Air Squared is proposing the development of a Zero-gravity Vapor Compression Refrigerator (ZVCR). The ZVCR is an oil-free, scroll driven, vapor compression food storage system. Similar to conventional systems, the ZVCR will include four major components: compressor, condenser, expansion device and evaporator. But, instead of a heavy and oil lubricated working fluid compressor, it will use an advanced oil-free orbiting type scroll compressor and expander. Its oil-free design will remove system's operational reliance on gravity while keeping the design compact & lightweight at higher efficiencies. For expansion work recovery, a scroll expander based on the same technology as the compressor will be implemented.

Estimated TRL at beginning and end of contract: (Begin: 4 End: 6)

Technical Objectives and Work Plan

The objective is to develop an efficient ZVCR based on vapor compression refrigeration technology leveraging Air Squared's oil-free scroll compressor and expander technology to remove the need for oil lubrication, increase performance, reduce size and weight, and increase reliability. During year 1 a highly instrumented alpha ZVCR prototype will be fabricated and tested. Building on the results from year 1, a fully integrated beta ZVCR prototype will be pursued with more aggressive testing in a relevant environment in fulfillment of TRL 6. The proposed effort is broken up into quarters over two years (8 quarters). Each quarter has a designated milestone and associated deliverables.

- Q1: Alpha Prototype Final Design and Bill of Material
- Q2: Alpha Prototype Component Fabrication
- Q3: Alpha Prototype Preliminary Performance Testing and Start of Life Testing
- Q4: Alpha Prototype Final Test Results
- Q5: Beta Hardware Fabrication and Procurement
- Q6: Beta Prototype Test Results
- Q7: Beta Prototype Final Test Results
- Q8: Full-Scale System Two Month Performance Demonstration and Final Reporting



NASA Applications

Engineered with an innovative shared scroll compressor, expander, and motor drive, the ZVCR transports the greater capacity and efficiency of earth food storage into space. Designed to increase the deliverable payload of NASA resupply missions to the ISS and beyond, the ZVCR is an efficient, compact, and reliable thermal controls system additionally applicable in NASA onboard atmospheric cabin pressurization temperature control and as a module environmental control system.

Non-NASA Applications

Implemented on military aircraft, the ZVCR would provide excellent waste heat rejection and thermal systems control of precise atmospheric temperatures and cabin pressurization. Due to the efficient vapor compression refrigeration, the ZVCR could increase storage life, capacity, and low temperature cooling as an active container system for aviation cold transportation of food and medical supplies.

Firm Contacts Bryce Shaffer
Air Squared, Inc.
510 Burbank Street
Broomfield, CO, 80020-1604
PHONE: (513) 466-2669

NON-PROPRIETARY DATA